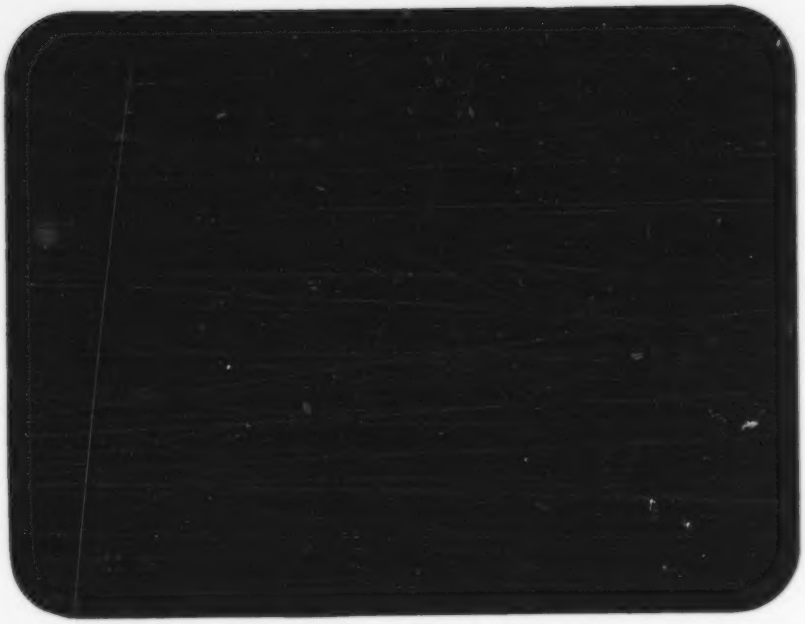

Province of British Columbia
Ministry of Forests
and Lands

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THE IMPORTANCE OF CHEMICALS IN CONTROLLING FOREST VEGETATION

MINISTRY OF FORESTS AND LANDS

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CONTENTS

Page

Executive Summary..... 1

A. The Need for Controlling Vegetation..... 2

B. Methods of Controlling Vegetation..... 2

C. History of the Use of Chemical Controls..... 4

D. Direct Effects of Banning Chemical Controls..... 5

E. Indirect Effects of Banning Chemical Controls..... 10

F. Conclusion..... 11

Appendices:

I: Testing Herbicides for Registration in Canada 12

II: Regulation of Herbicides in B.C..... 13

EXECUTIVE SUMMARY

Brush problems in B.C. forests are serious. Vegetation management must receive high priority on more than one million hectares of productive forest land currently dominated by non-crop growth. If no proper action is taken to manage vegetation, the total area of brush-dominated land is expected to increase by 75 000 ha per annum.

On each site, forest managers must consider all the available methods for controlling vegetation: manual, mechanical, burning, biological and chemical. As each method has advantages and limitations, each is used when it is appropriate. However, public concern over the chemical method is hampering its use. In B.C., the forest sector is being pressured to restrict or discontinue herbicide use in forests.

In some areas, the chemical control option is clearly the best choice. The loss of this option would mean a serious loss of forest yield. Other vegetation control efforts are frequently more costly and much less productive. The risks to workers in the field would increase sharply if manual methods replaced the use of chemical methods.

A ban on chemical controls in forests could further lead to pressures for a ban on chemical controls on farms, municipal lands, structures, and home gardens--with serious, direct consequences for all British Columbians.

The right to use chemicals to control unwanted vegetation in B.C. forests should not be withdrawn. In fact, the use of chemicals, properly and appropriately applied, should be encouraged as a safe, cost-effective option.

A. THE NEED FOR CONTROLLING VEGETATION

The need for controlling undesirable vegetation was probably first recognized in agriculture. Farmers learned to increase crop yields by reducing the competition for limited resources such as light, nutrients, and water.

In forests, the greatest competition to crops of conifers comes from woody plants that grow rapidly in height, herbaceous plants that spread through underground stems, and coarse grasses. As competitors, these forest weeds deprive young conifers of moisture, light, and nutrients. Further, the matted roots of certain woody species interfere with regeneration of conifers, increase planting costs, or create a need for site preparation. Some weed species, such as coarse grasses, fireweed and bracken, crush seedlings through snow compaction.

If new conifer plantations fail, a substantial portion of the initial investment is lost, and further reforestation and site preparation will be required to ensure that the site is returned to a productive state. The costs of these additional plantings average approximately $400 per hectare, doubling planting costs and increasing the overall investment.

B. METHODS OF CONTROLLING VEGETATION

There are five basic methods of controlling unwanted vegetation in forestry:

- -manual
- -mechanical
- -burning
- -biological
- -chemical

Each method has advantages and limitations. No single method is suitable for all problems or all sites. To ensure that the most appropriate method is selected, each one must be considered and judged according to certain criteria. The exploration of all options increases the likelihood of successful vegetation control with minimal environmental damage.

1. Manual Methods

Manual methods of removing unwanted vegetation include the use of hand-held tools or manually operated power cutting tools, such as sandviks, powersaws, girdling tools, and brushsaws. Manual methods are highly selective and may be used in sensitive areas with little negative impact on the site.

The major disadvantage of these methods is that cut stems of some species often resprout and continue to dominate the site. Other problems include high costs of initial treatments and the frequent requirement of repeat treatments. Damage to conifers from the slash and risks to workers using potentially

dangerous tools are drawbacks as well. On some areas, site conditions alone may impose insurmountable physical limitations.

2. Mechanical Methods

Mechanical methods use heavy equipment, often mounted on the front or rear of a tracked vehicle. These methods are generally fast and economical. They also provide access for planting and other silvicultural activities.

Problems associated with mechanical methods include resprouting, soil compaction, and exposure of mineral soil which creates a good seedbed for competing vegetation. Topography or soil type may limit or preclude the use of mechanical methods. Generally, their use is restricted to site preparation and is not suitable for brushing or for conifer release because of the damage done to seedlings by the equipment.

3. Burning Methods

Prescribed burning is only effective for site preparation. Results are obtained quickly and economically. Burning improves access on the site, thereby reducing planting costs. Currently, this is the most effective method of controlling certain vegetation problems such as salal on coastal sites.

However, weather and fuel conditions can severely limit the number of days available for safe and effective burning. Resprouting is another disadvantage of burning.

4. Biological Methods

Biological methods involve the use of organisms to control undesirable vegetation. Currently, grazing by cattle and sheep is the only method practised in B.C. Cattle are generally selective in terms of the target species that they eat. As sheep consume almost any vegetation, they can achieve a high level of short-term weed control, but they require long-term, on-site supervision to prevent damage to conifers. Investments in fences and watering reservoirs for grazing animals can be costly. Co-operation is required with wildlife managers to ensure that no problems occur with either encroachment into predator territory or transmission of disease and parasites to wildlife herds.

5. Chemical Methods

The main chemicals used to control vegetation are herbicides. Application methods include tree injection and foliar spraying using aerial or ground techniques. Use of herbicides causes little, if any, site disturbance and is generally the least costly method. With the selection of the correct herbicide and formulation, along with the proper timing, rate, application method, supervision, carrier type, and volume, excellent results have been achieved. Resprouting seldom

occurs.

However, special precautions must be taken when using herbicides; they cannot be applied on or near sensitive areas, such as water bodies. Herbicides cannot control all brush problems on all sites. In addition, the application period can be limiting, depending on the herbicide formulation, method of application, and target species. For example, if the objective is to control brush by foliar application of herbicides, treatment would have to occur within a period of four months or less.

C. HISTORY OF THE USE OF CHEMICAL CONTROLS

In Canada, the use of chemicals to control weeds was introduced experimentally in agriculture around 1896. Prior to this, application of chemicals had become a common practice in other parts of the world.

During the early 1900s, the use of herbicides rapidly gained popularity in agriculture even though their use cost approximately twice as much as manual controls. At that time, labour ($1.75 per 10-hour day) cost $0.05 per acre ($0.12 per hectare) and chemical applications cost approximately $1.00 per acre ($2.47 per hectare). Manual control, using a chisel hoe, cost approximately $0.55 per acre ($1.36 per hectare) per year for two or three treatments. The bare fallow option, using horse-drawn mechanical equipment, cost approximately $9.00 per acre ($22.24 per hectare) per year including labour and rental of the land.

Products used for spraying at that time included solutions of inorganic compounds such as salt or iron sulphate. These "first generation" herbicides were phased out with the introduction of synthetic organic herbicides, starting with 2,4-D in the mid-1940s.

Herbicides such as 2,4-D and 2,4,5-T were used in B.C. forests on a small scale from the mid-1950s to the late 1970s. Insect control through aerial spraying, however, was the major forest use of chemicals at that time.

During the latter part of the 1970s, the need for a vegetation control program became increasingly evident as the planting program increased. There was a serious loss of newly planted forests due to severe competition from weed species. At the same time, several new herbicides were introduced.

Today there are seven herbicides registered for forestry use in Canada. About 95% of the problem weed species can be controlled effectively with chemicals. However, public concern about environmental safety is severely restricting herbicide use on Crown land. In B.C., the forest sector is being pressured to restrict or discontinue the use of chemicals.

D. DIRECT EFFECTS OF BANNING CHEMICAL CONTROLS

The outcome of even a temporary ban on the use of herbicides for vegetation management would affect forest management and British Columbians in many ways. Specifically, a ban would affect:

-crops.
-treatment costs and productivity.
-worker safety.

1. Effects on Crops

In agriculture, where the use of chemicals is accepted as a primary means of weed control, the impact of non-treatment would be evident within a few years. Weed, insect, and fungus pests would drastically reduce the yield of most food crops. The immediate first year effect could be an overall reduction in yield of between 30% and 50%.[1] While chemicals represent about 2.0% of the growers' costs, they increase harvest by approximately 30 percent.

In forestry, due to a rotation time of 60 to 80 years, the immediate direct effects of banning herbicides are not as evident. A recent report suggests that over one million hectares of once productive forest land is now covered with deciduous brush of little or no value. This is land that could be producing a merchantable crop. At the minimum rate, it could generate over $20 million per year in stumpage alone. Additional benefits, in terms of employment and products, would also be realized.

2. Effects on Costs and Productivity

A review of various manual and chemical vegetation management projects was conducted to determine average costs and productivity involved for various methods. It is difficult to obtain conclusive information due to site-specific factors, such as slope, slash, access, size, density of target species, remoteness, and weather conditions. However, a summary of the information comparing the manual and chemical options is presented in Table 1. No comparison is made with the other treatment options due to the limitations previously mentioned.

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1 Canadian Agricultural Chemicals Association, A Position Statement, 1983

Table 1: Average Costs* and Productivity, Vegetation Management Projects, 1986

METHOD	COSTS ($/ha) Range	Average	PRODUCTIVITY (man hours/ha)
Manual			
Cutting	110-935	590	20.70
Girdling	460-910	510	29.75
Herbicide			
Spot gun	150-250	200	n/a
Hack & Squirt	290-750	350	13.36
Ground Spray	240-660	330	12.51
Aerial Spray	160-400	210	0.35

*Includes direct on-site costs plus overhead and supervision

The costs shown in Table 1 are the costs for a single treatment of a specific area. They are not the actual costs of controlling a particular vegetation problem for a complete rotation. Resprouts can continue to dominate areas previously treated by manual methods. This often necessitates additional treatments which must be added to the original cost per hectare. In the majority of cases, chemicals have achieved excellent vegetation control with a single treatment.

A considerable cost difference exists between manual cutting and chemical aerial spraying, (generally by helicopter). The chemical treatment costs $380 per hectare less, primarily due to the lower labour costs involved.

The costs of manual cutting of small target species (shorter than two metres) are on the lower end of the range and are comparable to chemical spraying using backpacks or trailer mounted sprayers. Although both methods require covering the entire site, spraying takes considerably less time than manual cutting.

In controlling large deciduous trees, stem injections with herbicides are about $160 per hectare less than manual girdling. In addition, less physical effort is required to treat stems by the chemical method.

Manual cutting may be carried out at certain times of the year with reasonably good results. Some studies recommend treatment during the late summer; others recommend the dormant period or early summer. Although more data are required, it is possible that this optimum treatment period could be as short as a few weeks, could vary from site to site or from year to year, and could vary according to plant species.

a. Cost Comparison

During the 1986/87 fiscal year, a total of 26 500 ha of forest lands in B.C. received herbicide treatment. Based on the data supplied in Table 1, the following is a cost comparison of the 1986/87 program by manual and chemical methods.

Table 2: Cost Comparison of Manual and Chemical Methods

METHOD	AVERAGE COST/HA($)	TOTAL COST($)
Manual	550	14 575 000
Chemical	275	7 287 500
Difference	275	7 287 500

As the data show, if the chemical option had not been available during 1986/87, and the same level of program had been maintained using manual methods, costs would have increased by over $7 million or by 100%.

A review of the brushing program since 1981 shows that a comparable balance in hectares treated by manual and chemical means was maintained until 1984. In recent years, preference has been shown for the chemical option. Data are presented in Table 3.

Table 3: Brushing and Weeding Program

FISCAL YEAR	AREA (HA)	PERCENT OF AREA TREATED	
		Manual	Chemical
81/82	3 260	68	32
82/83	4 423	49	51
83/84	7 054	50	50
84/85	16 510	35	65
85/86	18 527	29	71
86/87	21 488	31	69

Indications are that the percentage of area for manual and chemical treatment will stabilize at the current level of 30% manual and 70% chemical. Based on this assumption and current treatment costs (Table 2), the following is a projection of the brushing program for the next five years.

Table 4: Five Year Projection of Treatment by Method

YEAR	AREA (ha)	MANUAL Ha	MANUAL $	CHEMICAL Ha	CHEMICAL $
87/88	25 000	7 500	4 125 000	17 500	4 812 500
88/89	30 000	9 000	4 950 000	21 000	5 775 000
89/90	35 000	10 500	5 775 000	24 500	6 737 500
90/91	35 000	10 500	5 775 000	24 500	6 737 500
91/92	35 000	10 500	5 775 000	24 500	6 737 500
Total	160 000	48 000	$26 400 000	112 000	$30 800 000

Table 4 shows that although comparatively more area is being treated by chemical methods, the actual costs for the total program for each option are relatively close. If the manual controls were replaced completely with chemical treatment methods, the average annual savings would be about $2.64 million.

However, replacing manual cutting with a chemical program is possible in only about 75% of the cases. Chemicals are not permitted in all areas, (e.g., adjacent to water bodies). Still, if 75% of the manual program were replaced with a chemical program, a cost savings of approximately $2 million per year is feasible.

b. Productivity Comparison

As shown in Table 1, productivity for similar treatment methods favours the choice of the use of chemicals. A comparison of man-hour requirements for the 1986/87 program is shown in Table 5. In addition, estimates of man-hours required for manual treatment of a similar area are included.

Table 5: Estimates of Productivity, 1986 Chemical Program

METHOD	AREA (HA)	TOTAL MAN-HOURS Chemical	TOTAL MAN-HOURS Manual	DIFFERENCE
Aerial	7 736	2 708	160 135	157 427
Ground	5 802	72 583	120 101	47 518
Injection	7 950	106 212	236 513	130 301
Total	21 488	181 503	516 749	335 246
(Total in Man-Days)		22 688	64 594	41 906

As shown in Table 5, if treatments with chemicals were replaced with manual cutting, a 285% increase in the labour force would be required for a period of a few months every year. Even with current rates of unemployment, there is a lack of potential workers who are willing to undertake this type of

physical labour. It would be difficult to establish and maintain such a labour force.

A recent report by the Canadian Forestry Association on the brush problem in Canada states that not only is manual brushing seven to 15 times more expensive than chemical treatments, but it would need manpower in numbers that are simply not available in the remote locations requiring treatment.

3. Effects on Worker Safety

Vegetation management, for the purpose of brushing or conifer release, is only effective using manual or chemical methods. The potential for worker injury exists with both options, but safe work habits can significantly reduce this potential.

a. Safety Using Chemical Methods

Because herbicides are toxic chemicals, workers using them wear protective clothing. Face shields and respirators almost eliminate the threat of oral exposure. Dermal exposure, through contact with unprotected skin, is significantly reduced through the use of coveralls and gloves. Workers also use safe work habits while mixing, applying, and disposing of herbicides.

The most widely accepted measure of pesticide toxicity is LD50. It is expressed as the number of milligrams of toxicant per kilogram of body weight of an animal sufficient to kill 50% of those animals. The quantity of product and mixed or diluted solution required for oral consumption by a 75-kilogram person to achieve the LD50 level is shown in the following table for the two main forestry herbicides used in B.C.

Table 6: Amount of Product and Mixed (Diluted) Solution a Worker Would be Required to Ingest to Reach the LD50 Level (Assumed Body Weight of 75 kg)

HERBICIDE	PRODUCT		MIXED SOLUTION
	(g)	(oz.)	(litres)
Vision (glyphosate)	910.11	32.10	15.169
Forestamine (2,4-D)	56.25	1.98	0.938

As shown in Table 6, an average worker would have to consume almost a litre of mixed solution of Forestamine to achieve the LD50 level. Due to the lower toxicity of Vision, a worker would have to consume over 15 litres of mixed solution to achieve the LD50 level.

Both of these herbicides are readily expelled from the body. Chronic or long-term accumulation in the body is not

considered to be possible. Greater quantities of herbicides are required to achieve the LD50 level through dermal exposure. For example, almost twice the amount of Vision would have to be absorbed through the skin to reach the LD50 level. The possibility of a worker injury, resulting from normal exposure to forest herbicides is extremely remote.

b. Safety Using Manual Methods

As noted in the productivity data previously quoted in this report, the application of manual methods takes almost three times longer than the application of chemical methods. This extensive on-site time creates greater exposure to potential dangers from vehicles, falling objects, sharp cutting equipment, loud noises, and exhaust fumes.

The chainsaw has become the standard tool for manual brushing. Workers are exposed to oral and dermal toxicity through gasoline fumes. Exhaust from chainsaws also exposes workers to further noxious substances. This exposure is intensified by poor ventilation in dense vegetation.

Although few serious incidents have occurred with powersaws, the potential is a constant risk. Overconfidence can lead to unsafe work practices which can result in personal injury. Overall, manual clearing with power tools carries the highest risk of chronic disease or major injury per area treated.[2]

E. INDIRECT EFFECTS OF BANNING CHEMICAL CONTROLS

Movements to restrict or ban the use of pesticides often result from a lack of knowledge, misinformation, or prejudice about chemicals. If a ban is imposed on one user group, it could also affect other users and chemical producers throughout the country.

1. Effects on Other Users

The potential effect of the reduction in the use of pesticides in agriculture (the largest user of pesticides in Canada) has already been mentioned, (Section D.1.). Curtailment of the use of pesticides in forestry might have a negative impact on their use in agriculture.

Users of pesticides in structural pest control and weed control in municipalities, health institutions, and private homes might also lose this option if forest pesticide use is banned. Loss of the chemical option for structural pest control could threaten wood structures, including heritage buildings. Municipalities, for weed control, would have to replace a single annual spray with multiple manual treatments.

2 Newton, Michael, and Frank Dost, Biological and Physical Effects of Forest Vegetation Management, 1984

2. Effects on Chemical Companies

It is somewhat ironic that the group to be least affected by a forest pesticide ban would be the chemical producers themselves. With less than 0.1% of their sales going to forestry, they view this use only as a minor market. Its loss would have little impact on manufacturers.

However, if a ban on forestry uses of pesticides led to bans on other uses, then chemical manufacturers would be deeply affected. Such action would seriously affect the chemical research labs that have helped create the high standard of living we enjoy. Research carried out by manufacturers to develop new products has often led to new inventions completely unrelated to the original research objective.

F. CONCLUSION

If the brush problems in B.C. forests were minimal, more costly methods of treatment might be acceptable. Unfortunately, the current problems are immense. Vegetation management must receive high priority on more than one million hectares of productive forest land (good and medium sites only) currently dominated by non-forest crop vegetation. If no proper vegetation management action is taken, the recent silviculture review shows that an additional 75 000 ha per annum (a significant proportion of the 230 000 ha logged each year) will likely return to brush.

The problem is now being addressed by the Ministry of Forests and Lands through the Intensive Forestry Program and by the forest industry through Section 88 funding. As the people of B.C. are either directly or indirectly funding the vegetation management program, forest managers must be able to select the most productive, cost-effective, and safe methods of weed control.

If no action is taken to correct the problem, future levels of harvesting will have to be reduced. This would result in reduced industrial activity, employment, and revenues to the provincial government. To maintain current lifestyles, personnal taxation would likely have to be increased.

APPENDIX I: Testing Herbicides for Registration in Canada

The Pesticide Section, Evaluation Unit of Agriculture Canada receives applications from manufacturers seeking registration for pest control products. Several federal agencies examine each product and evaluate the manufacturers' test data regarding the product's effectiveness, toxicity, safety, effects on fish, wildlife and micro-organisms, and its persistence in the environment. These federal agencies include:

- -Agriculture Canada
  - -Laboratory Services Divison
  - -Pesticides Division
  - -Canadian Forestry Service
- -Environment Canada
  - -Environmental Protection Service
  - -Canadian Wildlife Service
- -Fisheries and Oceans Canada
  - -Fish Habitat Management Branch
- -Health and Welfare Canada
  - -Environmental Health Directorate

After a period of up to 10 years of assessment and study, Agriculture Canada makes a decision on registration. If a product is registered, it must be marketed with a label, a legal document that specifies the conditions and safeguards of usage. The product is registered to control a specified pest for a specified crop in a specified manner of application.

APPENDIX II: Regulation of Herbicides in B.C.

The Pesticide Control Branch, Ministry of Environment and Parks receives applications to use herbicides on forests and other public land in B.C. The applicant must specify the site, purpose, conditions for use, amount of herbicide to be used and, the method of applying the herbicide. The location of water bodies and other sensitive areas must be delineated on a map.

The complete permit application is reviewed by a number of agencies:

-The Ministry of Forests and Lands assesses the usefulness of the application to forest management.

-The federal Department of Environment, Environmental Protection Service, reviews the application on behalf of the Department of Fisheries and Oceans.

-The Ministry of Environment and Parks, Pesticide Control Branch, Wildlife Branch and recreational Fisheries Branch, consider the possible impacts of the herbicide use on the environment and the wildlife and fisheries resources.

-The Ministry of Health evaluates its potential impact on the public, including possible impact on potable water.

-The Ministry of Agriculture and Fisheries evaluates possible impact on agriculture.

With the assistance of these agencies, the Pesticide Control Branch grants or denies a permit. Any permit outlines detailed restrictions such as dosage rates, buffer zones, and timing of the herbicide treatment.

The granting or denial of a permit can be appealed by any individual or group through the Environmental Appeal Board, Ministry of Environment and Parks.